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DRAWINGS ATTACHED

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(54) APPARATUS FOR THE AUTOMATIC DETERMINATION OF FIBRE LENGTH DISTRIBUTION OF A COLLECTION OF FIBRES

(71) I, ERIC SCHWARZ, a citizen of the United States of America, of Hochstrasse 9, 8044, Zurich, Switzerland, do hereby declare

the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to apparatus for automatically determining the fibre length distribution of a fibre collection or stock. Suitable fibres are cotton fibres. Such apparatuses are already known and are based on the optical scanning of a fibre sample (so-called fibre beard) taken from a fibre collection and distributed in a predetermined manner along a comb. Then the fibres clamped by the comb, after being brought into parallelism, are mounted on the travelling comb carrier of an automatic testing instrument and passed slowly under the length of an elongate light beam at a constant speed. On the side of the fibre beard opposite the light source there is a photocell which determines the amount of light that passes through the fibre beard. The amount of light adsorption by the fibre beard at any point serves as a direct indication of the number of fibres at that point. This number of fibres is registered as a function of the distance advanced by the comb carrier and permits an indication of the fibre length distribution of a particular fibre beard to be obtained by graphic or digital methods as disclosed in MELIAND-TEXTILBERICHTE 6/1964, pages 603 to 608.

To determine a fibre length distribution, it is necessary, therefore, to prepare representative fibre beards. Formerly, such fibre beards were prepared by handcombing the fibre collection to be tested with a suitable comb in which the fibres were caught, and then by means of brushes or other combs made parallel; this preparation of fibre beards was found to be unsatisfactory and did not furnish test results representative of the fibre collection. Methods to improve the preparation of such fibre beards have already been made, such as that disclosed in United States Patent No. 3,057,019 in which bunches of a fibre collection are put inside a stationary drum in such a way that a number of tufts extend through perforations in the drum shell. A comb, extending in an axial direction along the circumference of the drum shell, is revolved around the shell, first passing over the section containing the perforations, for the purpose of combing out a number of fibres from the protruding tufts. These combed out fibres are held in the comb by a clamping device. Continuing the revolving motion, the comb passes over a section of the drum shell provided with a card, which serves to parallelize the fibres caught in the comb. The comb and thus prepared clamped fibre beard are removed from the drum, then brushed by hand, or otherwise treated, in order to remove any or all foreign matter, including short fibres not caught by the comb, and then finally mounted on the comb carrier of the previously mentioned test instrument, and tested.

Although fibre beards prepared in such manner furnish satisfactory and reproducible results with reference to the fibre length distribution of respective fibre collections, and handling of the apparatus for preparing these fibre beards is unsatisfactory, since the entire test procedures, consisting of the preparation of the fibre beard, its further handling, the mounting of the comb on the test instrument, and lastly the carrying out of the test procedures, altogether requires a considerable amount of time. Since there are usually quite a number of fibre beards necessary to be tested from an unknown fibre collection in order to determine the fibre length distribution, the need exists to improve the entire apparatus.

According to the present invention there is provided apparatus for the automatic determination of the fibre length distribution of a collection of fibres, comprising a drum for con-

taining a collection of fibres and bounded by a shell, and a comb positioned outside the shell so that the drum and the comb are relatively movable, the shell having a perforated zone through which fibre tufts contained in the collection can protrude and a fibre processing zone, and the comb having associated therewith a clamping device for retaining on the comb any fibres extracted from the perforations formed in the perforated zone of the shell, the arrangement being such that during relative movement of the comb and the perforated zone of the shell a fibre beard is extracted by the comb and retained thereon by the clamping device, and during subsequent relative movement of the comb and the processing zone cards carried in this zone act to parallelise the fibres of the beard; said apparatus further including means for effecting advance of the comb and the beard retained thereon in a direction parallel to the lengths of the fibres acted upon by the comb, relatively to the path of a light beam disposed to pass through the beard during such advance in the course of subsequent movement of the comb and beard relative to a further zone of the shell, a detector for detecting the light passing through successively following portions of the beard during such advance and for generating an electrical output signal dependent upon the amount of light reaching the detector, means for evaluating the electrical output signal to indicate the fibre length distribution of the collection, and means for releasing the clamping device so that the beard after having its fibre length distribution determined can be removed from the comb to render the comb ready to extract another fibre beard from the collection.

In order that the present invention may more readily be understood, the following description is given, by way of example, with reference to the accompanying drawing in which the sole Figure shows a schematic top plan view of one embodiment in partial cross section.

In the illustrated embodiment an open drum 10 is partially filled with a bunch of the fibre collection to be tested, which can be a cotton bunch. In a bottom section 12 of the drum 10 is a swinging arm 13, which revolves on its axis 14, and is so mounted that by using the handle 16, it can be revolved around the drum from the starting position A in the direction of the arrow 15. On swinging arm 13 a comb 17 is fixed, which serves for the preparation of the fibre beard. Contrary to the already known devices for the preparation of fibre beards by means of a drum, the comb 17 does not need to be detached from the swinging arm 13 after the beard has been prepared. Close to comb 17, on swinging arm 13, is a clamping device to clamp the combed out fibres, which clamping device, for example, could consist of a cylindrical clamping roller 18 which can be pivoted eccentrically about an axis 19, which is itself fixed in relation to the swinging arm 13.

During operation of the apparatus swinging arm 13 is moved from starting position A in the direction of the arrow 15, so that the comb 17 passes in succession the angular sections 20, 21, 22, 23, 24, 25, 26, 27 and 28 of the drum shell and then again returns to starting position A. The comb 17 does not touch the surface of the drum, but passes close to it at a distance which makes possible the formation of a fibre beard trailing behind the comb. The drum shell at angular section 21 is provided with perforations 29 of such a size as to cause fibre tufts 30 to protrude through the perforations from the fibre bundle 11 placed in the interior of the drum. From these fibre tufts 30, a great number of single fibres will be combed out by the teeth of comb 17, and will be caught in between the teeth of the comb 17. When passing angular section 22, the clamping roller 18 will be turned in the direction of the arrow by means of a suitably constructed control component mounted on the drum shell; i.e. the roller 18 will press the back ends of the teeth of comb 17 inwardly and will thereby clamp the fibres caught in between the teeth. During the continuing further rotation of swinging arm 13, the clamping roller 18 will remain in this position, so that the combed out fibres, or at least most of them, will remain caught.

In angular section 23, comb 17 with its clamped fibre beard passes over a number of cards 31 which, in a known manner, bring into parallelism the moving fibres caught in comb 17, which extend backwards counter to the direction of the arrow 15, whereby simultaneously the short fibres not firmly caught, fibre neps and foreign material are combed out of the fibre beard. During the passage through angular section 24, further steps can be taken to improve the homogeneity of the fibre beard, i.e. the clamping roller 18 can be somewhat loosened temporarily and then tightly clamped again, in order to give single fibres the opportunity to be re-orientated. In angular section 25, cards 32 are again provided which effect further combing out and parallelisation of the single fibres in the fibre beard.

Angular section 26 following can serve to provide further handling stations which might be desired for the preparation of the fibre beard. For example, it is advantageous to mount a brush 33 to rotate in the direction indicated by the arrow, by means of which an additional number of short fibres not clamped in the clamping device of the comb can be combed out, as well as to provide general smoothing out of the fibre beard which is moving in the direction of arrow 15. If so desired, a vacuum suction device, in addition to or in lieu of brush 33, can be provided.

In passing through angular section 27, as shown in the illustrated embodiment of the apparatus, the optical scanning of the fibre beard which has been prepared in the described manner, takes place, which procedure will be described in more detail below. Travelling over angular section 28, the swinging arm 13 finally returns to its starting position A. During this part of the revolving motion, the clamping roller 18 will be turned back again to the position shown in the drawing, and then the fibres caught in between the teeth of the comb 17 are loosened, and, simultaneously, air is supplied through a tube 34 which, passing through nozzle holes 35, will form a radially outward airflow directed towards the comb 17. In this manner, therefore, by the time the swinging arm 13 regains its starting position, removal of the fibre beard clamped to the comb 17 will have been effected by blowing, so that from starting point A onwards the described operational cycle will begin again instantaneously, i.e. a new fibre beard will be automatically prepared and tested. The disposal of the fibre beard, if desired, can alternatively be achieved by suction.

By means of the described device it is possible to prepare one fibre beard after another and in the same apparatus perform one test after the other to determine the fibre length distribution, without removing the fibre comb holding the prepared fibre beard from the drum or the swinging arm and placing it on a testing instrument.

The determination of the fibre length distribution can be carried out by various methods depending upon the construction and design of the respective optical cmoponents used. As shown in the drawing, there is on swinging arm 13, close to the base of comb 17, an elongate light source 36 in an enclosure 37, as well as a transparent plate 38, which can serve as a support for the fibre beard prepared on comb 17. Provision is made, in a known manner, for the light intensity at the outside surfade of the transparent plate 38 to be generally constant, so that the same amount of light prevails at any point on the fibre beard clamped to comb 17. As soon as swinging arm 13 enters angular section 27, the transparent plate 38, with the fibre beard lying on it, passes over the slit 39 in the drum shell extending parallel to its axis 14, behind which slit phototransmissive medium 40 is provided. The medium 40 is optically connected to a detector (not shown) which converts the light penetrating slit 39 into a proportional electrical signal. During the passage of the fibre beard clamped to comb 17 over slit 39, i.e. at the time of the passing of swinging arm 13 over angular section 27, a light beam of intensity dependent upon the amount of light absorbed by the fibre beard in the corresponding angular section, will enter the medium 40. The electrical signal emitted by the detector will be in direct proportion to the number of fibres in the fibre beard at each position along the path of swinging arm 13 in angular section 27.

The electrical signal emitted by the detector will be transmitted, jointly with a second signal corresponding to the angular position of swinging arm 13 in angular section 27, by means of electrical wiring, to an evaluating device, which can be of conventional type and which, according to requirements, will either draw a so-called Fibrogram of the fibre lengths, indicating the number of fibres (in % by weight), or will indicate directly from the corresponding values of both electrical signals, through electronic calculations, the desired specific digital values pertaining to the tested fibre beard.

It is easily possible in the described example to automate completely the movement of swinging arm 13 to make it undergo a steady reolving motion from starting position A as far as the beginning of angular section 27. In the latter angular section, the speed of rotation is then preferably reduced, and control of the revolving motion is taken over by a device capable of transmitting an electrical signal in proportion to the angular position of the swinging arm to the evaluating instrument. Naturally, there also have to be corresponding control components on the drum shell which not only effect, as in angular section 22, rotation of the clamping roller, but also bring about especially when reaching and passing over angular section 27, the triggering of the electrical signals necessary for the evaluation of the optical scanning of the fibre beard.

The above described apparatus for testing the fibre beard can also be equipped with a stationary light source which can be arranged within a certain radial distance outside slit 39, in such a manner that the fibre beard clamped to comb 17 can freely pass through the gap between the light source and the slit 39. With this arrangement the light source 36 in enclosure 37, and the transparent plate 38 mounted on swinging arm 13 are omitted.

If desired, in lieu of the photo-transmissive medium 40, a light source can be installed in the interior of the drum 10 along the slit 39. In this case the enclosure 37, mounted on the swinging arm 13, has to have, instead of transparent plate 38, a photo-transmissive medium which must be connected to a detector. Also in this case, enclosure 37 and the medium and detector have to be mounted in a stationary position at a certain radial distance from slit 39, and the fibre beard clamped to the comb 17 must be able to pass freely through the gap between the slit 39 and the medium.

Naturally, the drawing illustrates only one of many possible examples of the invention. Any layout can be set up which incorporates a drum whose shell has sections provided with perforations and cards respectively which sections form only the first part to be passed dur-

ing a complete revolving cycle of the comb, so that in a further part of the shell the comb, with its fibre beard, will pass all the further stations required for preparation of the fibre beard. Next, the thus prepared fibre beard must reach a position where its optical scanning will occur by means of a light beam moving with respect to the comb in the direction of the length of the fibres, so that the light penetrating through the fibre beard can be converted into an electrical signal throughout the period of this movement. Finally, the loosening of the clamped fibres in the comb is necessary, so that the fibre beard can be disposed of and the apparatus made ready for a further cycle of operation. It is preferable, as described above, to have the drum fixed in a stationary position and the comb with the fibre beard revolve around it; embodiments are nevertheless possible where, on the contrary, the drum shell is turned in relation to a stationary comb. The drum described above need not necessarily be of cylindrical shape but can, if desired, have an oval or rectangular cross section. In such a case, the comb will be guided by a rail mounted on the outside of the drum.

WHAT I CLAIM IS:—

1. Apparatus for the automatic determination of the fibre length distribution of a collection of fibres, comprising a drum for containing a collection of fibres and bounded by a shell, and a comb positioned outside the shell so that the drum and the comb are relatively movable, the shell having a perforated zone through which fibre tufts contained in the collection can protrude and a fibre processing zone, and the comb having associated therewith a clamping device for retaining on the comb any fibres extracted from the perforations formed in the perforated zone of the shell, the arrangement being such that during relative movement of the comb and the perforated zone of the shell a fibre beard is extracted by the comb and retained thereon by the clamping device, and during subsequent relative movement of the comb and the processing zone cards carried in this zone act to parallelise the fibres of the beard; said apparatus further including means for effecting advance of the comb and the beard retained thereon in a direction parallel to the length of the fibres acted upon by the comb, relatively to the path of a light beam disposed to pass through the beard during such advance in the course of subsequent movement of the comb and beard relative to a further zone of the shell, a detector for detecting the light passing through successively following portions of the beard during such advance and for generating an electrical output signal dependent upon the amount of light reaching the detector, means for evaluating the electrical output signal to indicate the fibre length distribution of the collection, and means for releasing the clamping device so that the beard after having its fibre length distribution determined can be removed from the comb to render the comb ready to extract another fibre beard from the collection.

2. Apparatus according to claim 1, wherein the further zone of the shell is provided with a slit passing therethrough whereby the light beam can pass between the interior and exterior of the shell through a beard retained on the comb during such advance.

3. Apparatus according to claim 2, wherein a photo-transmissive medium is positioned to transmit light from the slit to the detector.

4. Apparatus according to claim 3, wherein the photo-transmissive medium is located within the shell.

5. Apparatus according to claim 2, 3 or 4, wherein the comb is provided with an elongate light source which extends transversely of the direction of relative movement of the comb and the further zone of the shell and which is carried by the comb to provide evenly distributed illumination of the fibre beard retained on the comb.

6. Apparatus according to claim 2, 3, or 4, including an elongate light source extending transversely of the direction of relative movement of the comb and the further zone of the shell, said light source being fixed relative to the drum and positioned radially outwardly from the slit in such a manner as to form a gap between the light source and the slit to accommodate relative movement of the comb and beard through the gap.

7. Apparatus according to claim 2 or 3, including an elongate light source extending transversely of the direction of relative movement of the comb and the further zone of the shell, said light source being positioned in optical alignment with the slit in the interior of the drum.

8. Apparatus according to claim 5, 6 or 7, wherein the length of the light source lies in the same direction as the length of the slit, and the light source extends the full length of the slit.

9. Apparatus according to claim 7, when appendant to claim 3, wherein the photo-transmissive medium is positioned outside the drum.

10. Apparatus according to claim 9, wherein the photo-transmissive medium is fixed relative to the drum, and extends the full length of the slit in the direction of the light source, a gap being formed between the slit and the photo-transmissive medium, to accommodate relative movement of the comb and beard through the gap.

11. Apparatus according to any one of the preceding claims, wherein a device for blowing or sucking away the fibre beard is located in a recess in the shell of the drum adjacent the

position of the comb at the time of operation of the releasing means.

12. Apparatus according to any one of the preceding claims, wherein a rotary brush is provided in the fibre processing zone for smoothing the fibre beard.

13. Apparatus according any one of the preceding claims, wherein a suction device is provided in the fibre processing zone for cleaning the fibre beard.

14. Apparatus according to any one of the preceding claims, including a guide extending around the drum and equipped with control means for actuating the clamping device.

15. Apparatus according to any one of the preceding claims, including a support for maintaining the drum in a stationary condition so that the comb is movable with respect thereto.

16. Apparatus according to any one of the preceding claims, wherein the drum is of cylindrical configuration.

17. Apparatus according to any one of claims 1 to 15, wherein the drum has a rectangular cross-section.

18. Apparatus according to any one of claims 1 to 15, wherein the drum has an oval cross-section.

19. Apparatus for the automatic determination of the fibre length distribution of a fibre collection, such apparatus being constructed and arranged substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.

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1244347 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*